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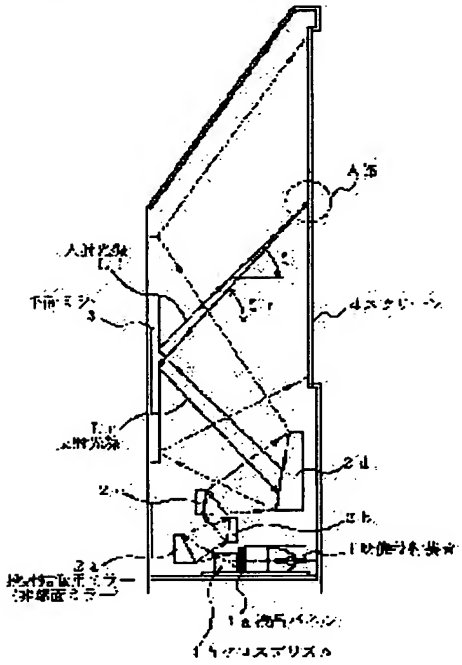
(54) REAR PROJECTION TELEVISION



(57)Abstract:

PROBLEM TO BE SOLVED: To erase a ghost image occurring in the case a light ray reflected on an emitting surface of a total reflection type Fresnel lens used as a screen reenters into the screen through a turn back mirror in an optical projection path of a rear projection television, or to lower the ghost image to a level that can not be identified by the naked eye, and to improve the quality of a projection image.

SOLUTION: A treatment for improving the transmission rate or a satin treatment is carried out for the emitting surface of the total reflection type Fresnel lens used as the screen, and the amount of the reflected light ray on the emitting surface of the total reflection type Fresnel lens, which causes the ghost image to occur, is reduced. Furthermore, the angle of a reflecting plane in a prism section of the total reflection type Fresnel lens is set so that the light ray reflected on the emitting surface of the total reflection type Fresnel lens cannot reenter into the screen even in the case the light ray is reflected again by the turn back mirror.

CLAIMS

[Claim(s)]

[Claim 1] The image projection arrangement which has the image display section which forms an image and projects the image of said image display section, In rear projection television equipped with the screen which displays an image, and the image image formation optical system which projects the image from said image projection arrangement on said screen tooth back It changes

with the total reflection type Fresnel lens with which said screen tooth back arranges the prism to which an incident ray is reflected in by total reflection, and the travelling direction is changed to concentric circular, and changes. The incident angle of the beam of light which reflects by said prism and carries out incidence to the outgoing radiation side of said total reflection type Fresnel lens at 0 times or about 0 times And the include angle zeta which the beam of light which carries out outgoing radiation of said image image formation optical system, and carries out incidence to said total reflection type Fresnel lens makes with a horizontal axis So that relation with include-angle zetar which said reflected ray which reflected in respect of total reflection type Fresnel lens outgoing radiation, and carried out outgoing radiation from the plane of incidence of said total reflection type Fresnel lens makes with a horizontal axis may fill zeta r>=zeta Rear projection television characterized by setting up whenever [tilt-angle / of the reflector in said total reflection type Fresnel lens plane-of-incidence side].

[Claim 2] Rear projection television according to claim 1 characterized by performing processing which raises transmission to a total reflection type Fresnel lens outgoing radiation side.

[Claim 3] Rear projection television according to claim 1 or 2 characterized by performing crepe processing scattered on a total reflection type Fresnel lens outgoing radiation side in incident light.

[Claim 4] Rear projection television given in any of claims 1-3 characterized by having the image projection device which has the mirror array which arranges two or more minute mirrors in the shape of a matrix, is made to reflect an illumination-light bundle in the direction of arbitration by posture change of said minute mirror, and performs image display they are.

[Claim 5] Rear projection television given in any of claims 1-4 characterized by using two or more aspheric surface mirrors for a screen for an image at projection and the image image formation optical system which carries out image formation they are.

[Claim 6] Rear projection television given in any of claims 1-4 characterized by constituting for an image projection and the image image formation optical system which carries out image formation from combination of plurality or one aspheric surface mirror, and projector lens on a screen they are.

[Claim 7] Rear projection television given in any of claims 1-6 they are on which a screen is characterized by having a total reflection type Fresnel lens and the lenticular lens arranged to said method of total reflection type Fresnel lens outgoing radiation presence.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to rear projection television which projects an image from a screen tooth back, and relates to rear projection television with thin depth which projects an image on a screen in a projection distance a high launch include angle, a high scale factor, and short especially, using a total reflection type Fresnel lens as a screen.

[0002]

[Description of the Prior Art] Rear projection television which projects an image from the tooth back of a screen like video projection television ("television" is hereafter written as "television") As theoretically shown in drawing 5 (a), the light which carries out outgoing radiation from an image projection arrangement (1) is suitably expanded according to optical system (a projection lens, mirror for projection image formation (2a) - (2d), etc.), and it projects from the tooth-back side of a screen (4), and has composition observed from the front face of this screen (4). In that case, in order to shorten depth of rear projection television, the flat-surface mirror for clinches (3) is arranged behind a screen (4). Image formation of the beam of light reflected by the flat-surface mirror for

clinches (3) is carried out to the screen (4) of rear projection television. As shown in the screen sectional view of drawing 5 (b), a refraction type Fresnel lens (5a) is used for a screen (4), and in order to turn the beam of light in an emission inclination in the fixed direction then, an image beam of light is bent so that it may become parallel to a horizontal axis h. However, with the screen configuration (a screen consists of only refraction type Fresnel lenses) as it is, since the beam-of-light angle of visibility of a screen becomes narrow, breadth is given to the beam of light of an image by arranging the lenticular lens (6) which is usually the aggregate of a cylindrical lens to the outgoing radiation presence side of a Fresnel lens (5a), and the means made bright to all the corners of a screen (4) is given.

[0003] However, rear projection television which used the refraction type Fresnel lens (5a) for the screen (4) the outgoing radiation light angle of refraction psi of a refraction type Fresnel lens (5a) -- a limitation -- it is -- the high launch include angle zeta (the include angle (zeta< 90 degrees) of the beam of light and horizontal axis h which carry out incidence to a screen (4) to accomplish --) It is difficult to amend the so-called projection beam of light of an elevation angle to a horizontal axis h to parallel (for it to be vertical incidence to the front face of incident angle theta3**0 degree, i.e., a screen, to the front face of a screen), and there is a difficulty in shortening depth. For this reason, as it changes to a refraction type Fresnel lens and is shown in the screen sectional view of drawing 5 (c), while preparing many concentric circular prism groups in the plane of incidence of a screen (4) The total reflection type Fresnel lens (5) which established the total reflection side Pr in each prism which forms this prism group is prepared. Rear projection television with the short depth used as the screen (4) of the structure which carries out total reflection of the beam of light which carried out incidence in respect of [Pr] total reflection, and carries out outgoing radiation to an observation, i.e., outgoing radiation side, side is proposed.

[0004]

[Problem(s) to be Solved by the Invention] Although rear projection television using the screen which has a total reflection type Fresnel lens can enlarge a launch angle and depth can be shortened The part reflects on a total reflection type Fresnel lens front face (outgoing radiation side), without the ability of a projection beam of light penetrating a total reflection type Fresnel lens on the outgoing radiation side of the total reflection type Fresnel lens used as a screen (4), as shown in drawing 3 . By re-reflecting this reflected ray Lr by the flat-surface mirror (3) arranged at the interior tooth back of rear projection television, re-incidence is carried out to the screen of a total reflection type Fresnel lens, and there is a fault which appears as the stray light (ghost image G) on a screen.

[0005] That a projection beam of light reflects on a total reflection type Fresnel lens front face (outgoing radiation side) has a cause in the permeability of the outgoing radiation side of the total reflection type Fresnel lens used as a screen. Usually, when a beam of light penetrates a body, the amount of a beam of light declines and outgoing radiation is carried out by the permeability which a body has. 100% of permeability does not exist a highly transparent body, and several% of light is surely absorbed in reflection on the interior of the body, or a front face. for this reason, a part of projection beam of light which was not able to be penetrated in respect of the outgoing radiation of a total reflection type Fresnel lens -- it will be absorbed within a total reflection type Fresnel lens, or it will be reflected on that close outgoing radiation front face, and a component will return to the plane-of-incidence side direction of a total reflection type Fresnel lens. As shown in drawing 5 (c), when the incident angle theta 3 carries out incidence to the outgoing radiation side of a total reflection type Fresnel lens at 0 times or the infinite include angle near 0 times, the beam of light reflected in respect of outgoing radiation goes back the same path as incident light. However, the case where the setup has not agreed completely whenever [tilt-angle / of the reflector Pr of the

beam of light which carried out incidence, and a total reflection type Fresnel lens], When the error has arisen in the screen of a total reflection type Fresnel lens, and physical relationship with an image projection arrangement (1) at the time of ******, rear projection television The include angle theta 3 in case change occurs also in theta 1 (refer to drawing 5 (c)) whenever [to a total reflection type Fresnel lens / incident angle], consequently a beam of light carries out incidence to a total reflection type Fresnel lens outgoing radiation side also becomes the value [times / 0] shifted. In such a case, outgoing radiation of the beam of light Lr reflected in respect of the outgoing radiation of a total reflection type Fresnel lens (5) is carried out from a total reflection type Fresnel lens (5) in the path shown in drawing 4 (drawing 3 B section enlarged drawing). That is, incidence of the beam of light projected at the launch include angle zeta is carried out to a total reflection type Fresnel lens (5) at an angle of theta 1, and it refracts and advances by plane of incidence with a Snell's law at the include angle of psi 1. Incidence of the beam of light after incidence is carried out to the reflector Pr of a total reflection type Fresnel lens (5) by theta 2. The beam of light which carried out incidence is reflected in Reflector Pr by angle of reflection theta 2, and it goes on to the total reflection type Fresnel lens outgoing radiation side Po (flat surface). Although incidence of the beam of light which advanced to the total reflection type Fresnel lens outgoing radiation side Po is carried out to the outgoing radiation side Po by the incident angle theta 3, the most carries out outgoing radiation ahead [the] from the outgoing radiation side Po and it is recognized by the watcher as an image, it reflects by angle of reflection theta 3, and incidence of the part is again carried out to plane of incidence Pi by the incident angle theta 4. It is reflected by angle of reflection theta 4, and incidence of the reflected ray Lr which carried out re-incidence to plane of incidence Pi is carried out to Reflector Pr by the incident angle theta 5, only an include angle psi 5 is refracted and outgoing radiation of it is carried out from Reflector Pr. Include-angle zetar of the reflected ray Lr in this case and a horizontal axis h to accomplish becomes smaller than the launch include angle zeta of an incident ray Li. Consequently, since a reflected ray Lr carries out incidence to the flat-surface mirror for clinches (3) and is reflected by shallow include-angle zetar (zeta r<zeta) as shown in drawing 3 , incidence of the reflected ray Lr is again carried out to the screen (4) of a total reflection type Fresnel lens, and the condition of a screen is worsened in an original image as the stray light (ghost image G) not existing.

[0006] The purpose of this invention is by mitigating to the level which cannot identify the above-mentioned ghost image with elimination or a naked eye to improve the image quality of a rear projection television screen.

[0007]

[Means for Solving the Problem] The image projection arrangement which rear projection television of this invention has the image display section which forms an image, and projects the image of the image display section, In rear projection television equipped with the screen which displays an image, and the image image formation optical system which projects the image from an image projection device on a screen tooth back It changes with the total reflection type Fresnel lens with which a screen tooth back arranges the prism to which an incident ray is reflected in by total reflection, and the travelling direction is changed to concentric circular, and changes. The incident angle of the beam of light which reflects by prism and carries out incidence to the outgoing radiation side of a total reflection type Fresnel lens at 0 times or about 0 times And the include angle zeta which the beam of light which carries out incidence to a total reflection type Fresnel lens makes with a horizontal axis It is characterized by setting up whenever [tilt-angle / of the reflector in a total reflection type Fresnel lens plane-of-incidence side] so that relation with include-angle zetar which the reflected ray which reflected in respect of total reflection type Fresnel lens outgoing radiation, and carried out outgoing radiation from the plane of incidence of a total reflection type

Fresnel lens makes with a horizontal axis may fill zeta r>=zeta. Consequently, reentry putting to a screen becomes that the travelling direction of the reflected ray reflected in respect of total reflection type Fresnel lens outgoing radiation does not have less through the clinch mirror inside rear projection television, and generating of a ghost image can be prevented. In addition, any of a configuration of having a configuration or a total reflection type Fresnel lens, and the lenticular lens arranged to the method of total reflection type Fresnel lens outgoing radiation presence only with a total reflection type Fresnel lens are sufficient as a screen.

[0008] Moreover, this invention is characterized by performing crepe processing which performs the processing which raises transmission (a reflection factor is decreased), i.e., nonreflective coating, (AR coating) to the outgoing radiation side of the total reflection type Fresnel lens which constitutes a screen, or are scattered on it in incident light in a total reflection type Fresnel lens outgoing radiation side. When the quantity of light of the reflected ray leading to a ghost image generated without being able to penetrate is decreased to a total reflection type Fresnel lens outgoing radiation side and a reflected ray carries out incidence to a total reflection type Fresnel lens again by this configuration, with the naked eye, that quantity of light decreases even in the condition which is not discriminable, and a ghost image will be in the condition which is not discriminable with the naked eye on a screen.

[0009] Furthermore, rear projection television of this invention is characterized by constituting an image from combination of the configuration which used two or more aspheric surface mirrors at projection and the image image formation optical system which carries out image formation, plurality or one aspheric surface mirror, and projector lens on a screen. Thus, since the aspheric surface mirror which can enlarge the launch include angle zeta of a projection beam of light (include angle of the beam of light and horizontal axis which carry out incidence to a screen to accomplish) is used for this invention compared with the projector lens or the flat-surface mirror, it can realize rear projection television with very thin depth.

[0010] Not only the image projection device that has a liquid crystal panel but the thing for which the image projection device which has the mirror array which arranges two or more minute mirrors in the shape of a matrix, is made to reflect an illumination-light bundle in the direction of arbitration by posture change of said minute mirror, and performs image display is used is possible for rear projection television of this invention of the above-mentioned configuration.

[0011]

[Embodiment of the Invention] (The 1st operation gestalt) The operation gestalt of this invention is explained by making drawing 1 and drawing 2 reference. In addition, it is ****** which drawing 1 is the outline block diagram of rear projection television of this invention, and drawing 2 is the A section enlarged drawing of drawing 1 , and shows the path of close and an outgoing radiation beam of light over a screen.

[0012] If drawing 1 is made reference, as for rear projection television of this operation gestalt, the image projection arrangement (1) is installed in the case pars basilaris ossis occipitalis. the red (R) who this image projection arrangement (1) used the liquid crystal panel (1a) for the image display section, and was formed with the liquid crystal panel (1a) -- green -- it is the so-called liquid crystal projection arrangement which (G) and each blue (B) image beam of light are compounded, and carries out outgoing radiation by cross prism (1b). Ahead of the image projection arrangement (1), the mirror for projection image formation (2a) is installed, above the mirror for projection image formation (2a), mirror for projection image formation (2b) - (2d) is arranged alternately forward and backward toward the upper part one by one, and projection image formation optical system is constituted so that an optical path may become zigzag. A mirror for these projection image formation (2a) and image beam of light is reflective - Turned up by - (2d), and it goes on up one by

one. the tooth back in a case ahead of [of the mirror (2d) for projection image formation of the last stage] slant -- turning up -- business -- a flat-surface mirror (3) is installed and the screen (4) is arranged in the front face for clinches of a flat-surface mirror (3) slanting upper part front case. The beam of light which carried out outgoing radiation of the image projection arrangement (1) is reflective - Turned up by the flat-surface mirror for the mirror for projection image formation (2a) - (2d) clinches (3), progresses to zigzag, and is used as a screen screen (4) projection and image formation.

[0013] Thus, on rear projection television of this invention, two or more mirrors for projection image formation (2a) - (2d) and the flat-surface mirror for clinches (3) which consist of an aspheric surface mirror as components for image projection between an image projection arrangement (1) and a screen (4) are arranged from the purpose which shortens body depth more. Since an aspheric surface mirror is launched compared with a lens, a flat-surface mirror, etc. and can enlarge an include angle, it becomes the screen of the high scale factor in a short projection distance by using this mirror (2a) - (2d) for projection image formation, and becomes larger than the case where the launch include angle zeta of a projection beam of light (incident ray Li) uses the usual projection lens, further. Consequently, since also whenever [to a screen (4) / incident angle] becomes large and they are no longer shaded [clinch reflection of an incident light line does not interfere the components of a flat-surface mirror or others and], depth of rear projection television comes be made thinly sharply.

[0014] The total reflection type Fresnel lens (5) which changes from the prism group which established the total reflection side Pr (it is hereafter described as a reflector) to each prism in order to turn the beam of light in the emission inclination reflected by the flat-surface mirror (3) as shown in drawing 2 and drawing 5 (c) in the fixed direction is prepared in a screen (4) tooth back, and the image beam of light is bent so that it may become perpendicular to the front face of a screen which is the screen. Since it becomes difficult to amend the projection beam of light of a very high launch include angle zeta like this invention to parallel (theta3**0 degree) to a horizontal axis when a refraction type Fresnel lens (5a) is prepared in a screen tooth back as shown in drawing 5 (b) In this invention, it is considering as the configuration which prepares not a refraction type Fresnel lens (5a) but the Fresnel lens which used the total reflection of a beam of light by the same principle as prism, i.e., a total reflection type Fresnel lens, (5) in a screen tooth back, and performs angle correction of a beam of light. When the beam-of-light angle of visibility of a screen becomes narrow with the screen configuration which prepared the total reflection type Fresnel lens (5) in this tooth back, as shown in drawing 5 (c), breadth is given to the beam of light of an image by arranging the lenticular lens (6) which is the aggregate of a cylindrical lens to the outgoing radiation side of a total reflection type Fresnel lens (5), and an angle of visibility is made large. When the angle of visibility in the front face of a screen is large, it is not necessary to install a lenticular lens. With the gestalt of this operation, the former is adopted and it has screen composition which prepared the lenticular lens (6) in the front face of a total reflection type Fresnel lens (5) (at drawing 2 , a lenticular lens is an illustration abbreviation).

[0015] With the configuration using a total reflection type Fresnel lens (5), as shown in drawing 2 (a lenticular lens is an illustration abbreviation), incidence of the beam of light projected at the launch include angle zeta is carried out to a total reflection type Fresnel lens (5) at an angle of theta 1, and it refracts and advances by plane of incidence with a Snell's law at the include angle of psi 1 with the refractive index n of the incident angle theta 1 and the Fresnel lens quality of the material. Incidence of the beam of light after incidence is carried out to the reflector Pr of a total reflection type Fresnel lens (5) by theta 2. a total reflection type Fresnel lens (5) -- this incident angle theta 2 -- critical angle thetac (thetac=sin -1 (1/n) --) Since beta (include angle of Reflector Pr and vertical

axes v to accomplish) is set up whenever [tilt-angle / of Reflector Pr] so that n may become more than the refractive index of a Fresnel lens (theta2>=thetac) The beam of light which carried out incidence is theoretically reflected in Reflector Pr according to angle of reflection theta 2 with 100% of reflection factor like reflection of prism, and it goes on to the total reflection type Fresnel lens outgoing radiation side Po (flat surface). the include angle theta 3 which the advance include angle of the beam of light which carried out total reflection is setting up beforehand here so that it may become level, and carries out incidence to the total reflection type Fresnel lens outgoing radiation side Po -- 0 times -- or it becomes it is infinite and close to 0 times (if it becomes incident angle theta 3**0 times, it will become angle-of-reflection theta3**0 degree).

[0016] Since a total reflection type Fresnel lens (5) does not have the concept of a focal distance f unlike a refraction type Fresnel lens The launch include angle zeta which carries out incidence to each point of a screen (y) (y so that theta 3 may become theta3=0 degree or theta3**0 degree whenever [incident angle / in which the beam of light of position-coordinate (coordinate of perpendicular shaft orientations)) of the beam-of-light probe index on a screen finally carries out incidence to the total reflection type Fresnel lens outgoing radiation side Po] beta is set up whenever [face angle / of total reflection type Fresnel lens each plane of incidence Pi / alpha], and (the plane of incidence Pi of a total reflection type Fresnel lens, and include angle with vertical axes v to accomplish), whenever [tilt-angle / of Reflector Pr]. However, although theta 3 is made to theta3=0 degree or theta3**0 degree on the theory whenever [incident angle / of the beam of light which carries out incidence to the total reflection type Fresnel lens outgoing radiation side Po], in fact, it bends and the beam of light with a delicate screen which carries out outgoing radiation of the screen does not become as an original design value in many cases by mechanical gap of the physical relationship of an inclination, the criteria location of a screen, and an image projection arrangement etc. Therefore, a ghost image occurs on the projection screen of a screen with the reflected ray generated on the outgoing radiation front face of a total reflection type Fresnel lens which was stated on the above-mentioned trouble. for this reason, the processing which raises the amount of transmitted lights to the total reflection type Fresnel lens outgoing radiation side Po in this invention, for example, the dielectric multilayers which carried out the laminating of Si film and the SiO2 film by turns, -- or While decreasing the quantity of light of the reflected ray Lr which gives the nonreflective coat (AR coat) which consists of the dielectric multilayers which carried out the laminating of TiO2 film and the SiO2 film by turns, and serves as a ghost image So that the reflected ray Lr reflected in respect of [Po] total reflection type Fresnel lens outgoing radiation may advance the reflected light way shown in drawing 2 , without taking the reflected light way shown in drawing 4 that is It reflects in respect of [Po] total reflection type Fresnel lens outgoing radiation. include-angle zetar of the reflected ray Lr and horizontal axis h which carried out outgoing radiation from the total reflection type Fresnel lens (5) to accomplish becomes larger than the launch include angle zeta of the incident ray Li which carries out incidence to a total reflection type Fresnel lens (zeta r>=zeta) -- like -- whenever [face angle / of the plane of incidence Pi of a total reflection type Fresnel lens (5) / alpha] -- and the beam of light Lr which set beta (refer to drawing 2) as the specific include angle whenever [tilt-angle / of Reflector Pr], and was reflected in respect of [Po] total reflection type Fresnel lens outgoing radiation -- turning up -- business -- even if it carries out re-incidence to a flat-surface mirror (3), he is trying for a ghost image not to appear on the projection screen of a screen

[0017] For that, as shown in drawing 2 , incidence is carried out to the total reflection type Fresnel lens outgoing radiation side Po. The beam of light to reflect carries out incidence from the probe-index lower part of the outgoing radiation side Po, and carries out reflective advance upwards. As approximated in theta 3 by 0 times whenever [incident angle], whenever [face angle / of the

total reflection type Fresnel lens plane of incidence Pi of screen each point / alpha] And a reflected light way is in the method of incident light on the street of Setup Po, i.e., a total reflection type Fresnel lens outgoing radiation side, about beta whenever [tilt-angle / Of Reflector Pr]. beta is set up whenever [face angle / of the total reflection type Fresnel lens plane of incidence Pi in screen each point / alpha], and, whenever [tilt-angle / of Reflector Pr] so that it may become the include angle possible nearest to 0 times, i.e., the include angle it can be considered in approximation that is 0 times, about theta 3 whenever [to a total reflection type Fresnel lens outgoing radiation side / incident angle].

[0018] Thus, if include angles alpha and beta are set up, incidence of the beam of light which advanced to the outgoing radiation side Po will be carried out to the outgoing radiation side Po by the incident angle theta 3, the most will carry out outgoing radiation ahead [the] from the outgoing radiation side Po, it is recognized by the watcher as an image, and it will reflect by angle of reflection theta 3, and incidence of the residual part will be again carried out to Reflector Pr by the incident angle theta 4. It is reflected by angle of reflection theta 4, and incidence of the reflected ray Lr which carried out re-incidence to Reflector Pr is carried out to plane of incidence Pi by the incident angle theta 5, only an include angle psi 5 is refracted and outgoing radiation of it is carried out from plane of incidence Pi. At this time, include-angle zetar of the reflected ray Lr which carried out outgoing radiation from the total reflection Fresnel lens becomes larger than the launch include angle zeta of an incident ray Li, and a ghost image is not generated in order not to carry out incidence to a screen again, as shown in drawing 1 .

[0019] In a setup of include angles alpha and beta, following relational-expression (1) - (9) is used, and it is theta3=0 degree or theta3<0 degree (the time of a beam of light carrying out incidence from the probe-index lower part of the outgoing radiation side Po is defined as theta3<0 like drawing 4). the time of a beam of light carrying out incidence from the probe-index upper part of the outgoing radiation side Po was defined as theta3>0 -- it is -- and the include angles alpha and beta of each field are set up so that zeta r>=zeta, theta2>=thetac, and theta4 >=thetac may be filled theta3**0 degree.

theta1=90 -(90-alpha)- Zeta=alpha-zeta ... (1)

psi1=sin-1 (/n) (sintheta1)

= sin-1 (/n) (sin (alpha-zeta)) ... (2)

theta2=(90-alpha+psi 1)+(90-beta) =180-alpha-beta+psi 1 .. (3)

theta3=90-theta2-(90-beta) = beta-theta 2 ... (4)

theta4=90-(180-beta- (90-theta3)) = beta-theta 3 ... (5)

theta5=180-gamma-(90-theta4)-90=theta4-gamma ... (6)

psi5=sin-1 (nxsin theta 5) ... (7)

psi5=90-zetar-(90-alpha) = alpha-zeta r ... (8)

Alpha+beta+gamma = 180 ... (9)

theta 1 here Whenever [incident angle / of the incident ray Li to the total reflection type Fresnel lens plane of incidence Pi], Whenever [to the reflector Pr of the beam of light with which psi 1 carried out incidence of theta 2 into the total reflection type Fresnel lens whenever / angle-of-refraction / in the total reflection type Fresnel lens plane of incidence Pi / incident angle], Whenever [incident angle / of the beam of light which reflected theta 3 in the reflector Pr to the total reflection type Fresnel lens outgoing radiation side Po], Whenever [to the reflector Pr of the reflected ray Lr which reflected theta 4 in respect of / Po / total reflection type Fresnel lens outgoing radiation / incident angle], theta 5 -- the reflected ray Lr (the outgoing radiation side Po --) to the total reflection type Fresnel lens plane of incidence Pi psi 5 whenever [incident angle / of the light which carried out sequential reflection in Reflector Pr] Whenever [angle-of-refraction / of the

reflected ray Lr in the total reflection type Fresnel lens plane of incidence Pi] (outgoing radiation include angle of a reflected ray), zeta is an include angle (it changes respectively in the acute angle with adoption, the incidence location to a Fresnel lens, and projection optical system.) which the incident ray Li to a horizontal axis h accomplishes. zetar which is the so-called elevation angle is an include angle (adoption of the acute angle) which the reflective outgoing radiation beam of light Lr to a horizontal axis h accomplishes. The so-called inclination and alpha Whenever [tilt-angle / of the total reflection type Fresnel lens plane of incidence Pi], Namely, the include angle of plane of incidence Pi and vertical axes v (shaft perpendicular to a horizontal axis) to accomplish (alpha< 90 degrees), beta Whenever [tilt-angle / of the total reflection type Fresnel lens reflector Pr], i.e., the include angle of Reflector Pr and vertical axes v to accomplish, (beta< 90 degrees) the include angle (the constant value of 40 - 50 degrees is usually taken) and n to which the edge include angle of a total reflection type Fresnel lens point, i.e., Reflector Pr and plane of incidence Pi, accomplishes gamma -- the refractive index of a total reflection type Fresnel lens, and thetac -- a critical angle (thetac=sin -1 (1/n)) -- it comes out.

[0020] (The 2nd operation gestalt) The gestalt of this operation was changed to the improvement processing in permeability in which the nonreflective film was given to the total reflection type Fresnel lens outgoing radiation side, and has performed crepe processing to the total reflection type Fresnel lens outgoing radiation side. A setup of beta, the mirror for flat-surface mirror (3) for image projection device (1) clinches projection image formation (2a) - (2d) arrangement, etc. are [whenever / other configuration, i.e., face angle of total reflection type Fresnel lens plane of incidence Pi, / alpha /, and, whenever / tilt-angle / of Reflector Pr] the same as the 1st operation gestalt.

[0021] As for the beam of light which hit the crepe processing side of the total reflection type Fresnel lens outgoing radiation side Po, both the components of transparency and reflection serve as the diffused light (the degree of diffusion changes with the condition of surface crepe). For this reason, the component reflected in respect of [Po] total reflection type Fresnel lens outgoing radiation is diffused by crepe processing of the outgoing radiation side Po. Even when the total amount of the beam of light reflected temporarily itself remains as it is, the consistency of the beam of light of per an unit area (unit solid angle) decreases by diffusion. Consequently, the quantity of light which follows the path of the beam of light used as a ghost image as shown in drawing 3 and drawing 4 also decreases, and when a reflected ray Lr carries out re-incidence of the ghost image to a screen (4), it is decreasing even on the level which disappears completely or cannot be identified with the naked eye.

[0022] In addition, with the gestalt of this operation, since it is decreasing even on the level which disappears completely or cannot be identified with the naked eye when a reflected ray Lr carries out re-incidence of the ghost image to a screen (4) as mentioned above, it is not necessary to necessarily make a setup of the include angles alpha and beta of each field of a total reflection type Fresnel lens the same as the 1st operation gestalt. Moreover, since the reflected light which carries out reflective dispersion will decrease further if the nonreflective film (AR coat) is prepared in the field which carried out crepe processing, the ghost image prevention effectiveness improves further.

[0023] the above -- although any operation gestalt uses mirror (2a) - (2d) for projection image formation which changes from an aspheric lens to image formation optical system, as shown in drawing 6 , it may constitute image formation optical system from - (2c) (the number of the mirrors for image image formation does not necessarily need to be three) and the mirror (2a) for projection image formation, and a projector lens 7.

[0024] Moreover, although the image projection arrangement (1) showed the example using the image projection arrangement of the transparency mold which used the liquid crystal panel (1a), as

shown in drawing 7 (a) and (b), the mirror array which consisted of the minute mirror aggregates which arrange a minute mirror (12) in the shape of a matrix on the surface of a silicon substrate (11), and change may be used for it. As shown in drawing 7 (b), a minute mirror (12) is twisted, and this mirror array is supported by the beam (13), is installed on a silicon substrate, and forms 1 pixel by one minute mirror (12). A minute mirror (12) is rotated with the electrostatic suction force between the address electrodes (14) prepared in the silicon substrate surface on a minute mirror background. Thus, by turning on and off the electrical potential difference impressed to the address electrode 14, the posture of each minute mirror (12) is changed, respectively, the reflective direction of the light L from a light source lamp (10) is changed, an image is generated, and an image is projected with a projection lens (7) (drawing 7 (a)).

[0025]

[Effect of the Invention] This invention performs AR coat, crepe processing, etc. to a total reflection type Fresnel lens outgoing radiation side. While decreasing even to the extent that it is not discriminable with the part around it, and a naked eye when the reflected light appears again on a screen, the quantity of light of the reflected ray produced on the outgoing radiation front face of the total reflection type Fresnel lens leading to ghost image generating Since alpha was set as the include angle which cannot carry out incidence of the reflected light to a screen again whenever [tilt-angle / of the reflector of a total reflection type Fresnel lens / beta], and, whenever [face angle / of plane of incidence] It has decreased even on the level which cannot identify the light figure which does not exist on the projection screen of rear projection television properly speaking, and the so-called ghost image with disappearance or a naked eye.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The schematic diagram of rear projection television of this invention.

[Drawing 2] The total reflection type Fresnel lens sectional view showing the path of a close and an outgoing radiation beam of light for a ghost image not to occur with the A section enlarged drawing of drawing 1 .

[Drawing 3] Drawing showing a ghost image generating path.

[Drawing 4] The drawing 3 B section enlarged drawing showing a ghost image generating path (total reflection type Fresnel lens sectional view).

[Drawing 5] (c) is the screen configuration outline sectional view where (a) used the schematic diagram of rear projection television, and (b) used the refraction type Fresnel lens, and the screen configuration outline sectional view which used the total reflection type Fresnel lens.

[Drawing 6] The schematic diagram of rear projection television of this invention.

[Drawing 7] For (a), the schematic diagram of the image projection arrangement using the mirror array which consists of many minute mirrors, and (b) are the configuration schematic diagram of a minute mirror.

[Description of Notations]

1 Image Projection Arrangement

1a Liquid crystal panel

1b Cross prism

2a The mirror for projection image formation (aspheric surface mirror)

2b The mirror for projection image formation (aspheric surface mirror)

2c The mirror for projection image formation (aspheric surface mirror)

2d Mirror for projection image formation (aspheric surface mirror)

3 Flat-Surface Mirror for Clinches
4 Screen
5 Total Reflection Type Fresnel Lens
5a Refraction type Fresnel lens
6 Lenticular Lens
7 Projection Lens
10 Light Source Lamp
11 Silicon Substrate
12 Minute Mirror
13 Torsion Beam
14 Address Electrode

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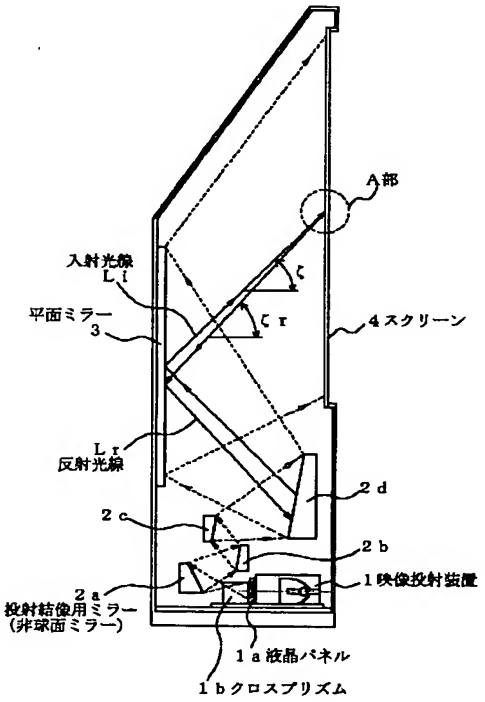
(54)【発明の名称】　リアプロジェクションテレビジョン

(57)【要約】
【課題】スクリーンとして用いる全反射式フレネルレンズの出射表面で反射した光線が、リアプロジェクションテレビの投写光路折り返しミラーを介してスクリーンに再入射して発生するゴースト像を消去、または肉眼では識別不能なレベルまで低下させ、投写画像の画質を向上する。
【解決手段】スクリーンとして用いる全反射式フレネルレンズ出射面の透過率向上処理又は梨地処理を施してゴースト像の原因となる、全反射式フレネルレンズ出射面で発生する反射光線の光量を減少すると共に、全反射式フレネルレンズのプリズム部の反射面の角度を、全反射式フレネルレンズ出射面で反射した光線が折り返し用ミラーで再反射してもスクリーンには再入射出来ない角度に設定する。



【特許請求の範囲】

【請求項１】　画像を形成する画像表示部を有し、前記画像表示部の画像を投写する映像投写装置と、画像を表示するスクリーンと、前記映像投写装置からの画像を前記スクリーン背面に投写する映像結像光学系とを備えたリアプロジェクションテレビジョンにおいて、前記スクリーン背面が、全反射により入射光線を反射してその進行方向を変化させるプリズムを同心円状に配列して成る全反射式フレネルレンズで成り、前記プリズムで反射して前記全反射式フレネルレンズの出射面に入射する光線の入射角が０度又はほぼ０度で、且つ、前記映像結像光学系を出射して前記全反射式フレネルレンズに入射する光線が水平軸となす角度ξと、前記全反射式フレネルレンズ出射面で反射して前記全反射式フレネルレンズの入射面から出射した反射光線が水平軸となす角度ξｒとの関係がξｒ≧ξを満たす様に、前記全反射式フレネルレンズ入射面側にある反射面の傾斜角度を設定したことを特徴とするリアプロジェクションテレビジョン。

【請求項２】　全反射式フレネルレンズ出射面に透過率を向上させる処理を施したことを特徴とする請求項１記載のリアプロジェクションテレビジョン。

【請求項３】　全反射式フレネルレンズ出射面に、入射光を散乱する梨地処理を施したことを特徴とする請求項１又は２記載のリアプロジェクションテレビジョン。

【請求項４】　複数の微小ミラーをマトリクス状に配置し、前記微小ミラーの姿勢変化により照明光束を任意の方向に反射させて画像表示を行うミラーアレイを有する映像投射装置を備えたことを特徴とする請求項１～３の何れかに記載のリアプロジェクションテレビジョン。

【請求項５】　画像をスクリーンに投影・結像させる映像結像光学系に複数の非球面ミラーを用いたことを特徴とする請求項１～４の何れかに記載のリアプロジェクションテレビジョン。

【請求項６】　画像をスクリーンに投影・結像させる映像結像光学系を複数又は１つの非球面ミラーと投射レンズとの組み合わせで構成したことを特徴とする請求項１～４の何れかに記載のリアプロジェクションテレビジョン。

【請求項７】　スクリーンが、全反射式フレネルレンズと、前記全反射式フレネルレンズ出射面前方に配置したレンチキュラーレンズとを有することを特徴とする請求項１～６の何れかに記載のリアプロジェクションテレビジョン。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、スクリーン背面から画像を投影するリアプロジェクションテレビジョンに係り、特に、全反射式フレネルレンズをスクリーンとして用い、高い打ち上げ角度と高倍率、且つ、短い投写距離で画像をスクリーン上に投写する、奥行きの薄いリアプロジェクションテレビジョンに関する。

【０００２】

【従来の技術】ビデオプロジェクションテレビジョン（以下、「テレビジョン」を「テレビ」と略記する）のようにスクリーンの背面から映像を投影するリアプロジェクションテレビは、原理的には図５（ａ）に示すように、映像投写装置（１）から出射する光を適宜光学系（投写レンズや投写結像用ミラー（２ａ）～（２ｄ）等）によって拡大して、スクリーン（４）の背面側から投影し、このスクリーン（４）の前面より観察する構成になっている。その際、リアプロジェクションテレビの奥行きを短くするためにスクリーン（４）の後方に折り返し用平面ミラー（３）を配置する。折り返し用平面ミラー（３）で反射した光線はリアプロジェクションテレビのスクリーン（４）に結像する。その時、発散傾向にある光線を一定の方向に向けるため、図５（ｂ）のスクリーン断面図に示すように、スクリーン（４）に屈折式フレネルレンズ（５ａ）を用いて映像光線を水平軸ｈに平行となるように曲げる。しかし、そのままのスクリーン構成（屈折式フレネルレンズのみでスクリーンを構成）では画面の光線視野角が狭くなるため、通常はシリンドリカルレンズの集合体であるレンチキュラーレンズ（６）をフレネルレンズ（５ａ）の出射面前面に配置することで画像の光線に広がりを持たせ、スクリーン（４）の隅々まで明るくする手段が施されている。

【０００３】しかし、スクリーン（４）に屈折式フレネルレンズ（５ａ）を用いたリアプロジェクションテレビは、屈折式フレネルレンズ（５ａ）の出射光屈折角ψに限界があり、高い打ち上げ角度ξ（スクリーン（４）に入射する光線と水平軸ｈとの成す角度（ξ＜９０度）、所謂、仰角）の投写光線を水平軸ｈに対し平行（スクリーン前面への入射角θ３≒０度、即ち、スクリーン前面へ垂直入射）に補正することが難しく、奥行きを短くするには難点がある。このため、屈折式フレネルレンズに替えて、図５（ｃ）のスクリーン断面図に示すように、スクリーン（４）の入射面に、同心円状の多数のプリズム群を設けると共に、このプリズム群を形成する個々のプリズムに全反射面Ｐｒを設けた全反射式フレネルレンズ（５）を設け、入射した光線を全反射面Ｐｒで全反射して観察側、即ち、出射面側に出射する構造のスクリーン（４）にした奥行きの短いリアプロジェクションテレビが提案されている。

【０００４】

【発明が解決しようとする課題】全反射式フレネルレンズを有するスクリーンを用いたリアプロジェクションテレビは打ち上げ角を大きくでき、奥行きを短くできるが、図３に示すように、スクリーン（４）として用いる全反射式フレネルレンズの出射面上で投写光線が全反射式フレネルレンズを透過しきれずにその一部が全反射式フレネルレンズ表面（出射面）で反射し、この反射光線

Ｌｒがリアプロジェクションテレビ内部背面に配置した平面ミラー（３）で再反射されることによって全反射式フレネルレンズのスクリーンに再入射して、画面上に迷光（ゴースト像Ｇ）として現れる欠点がある。

【０００５】投写光線が全反射式フレネルレンズ表面（出射面）で反射するのは、スクリーンとなる全反射式フレネルレンズの出射面の透過率に原因がある。通常、物体を光線が透過する場合には、物体の持つ透過率によって光線の量が減衰されて出射される。透明度の高い物体でも透過率１００％は存在することはなく、必ず数％の光はその物体の内部、または表面上で反射か吸収される。このため、全反射式フレネルレンズの出射面で透過出来なかった投写光線の一部成分は、全反射式フレネルレンズ内で吸収されるか、その入出射表面で反射されて全反射式フレネルレンズの入射面側方向に戻ることになる。図５（ｃ）に示す様に、全反射式フレネルレンズの出射面に入射角θ３が０度、または限りなく０度に近い角度で入射した場合、出射面で反射した光線は入射光と同じ経路を逆行する。しかし、入射した光線と全反射式フレネルレンズの反射面Ｐｒの傾斜角度設定が完全に合致していない場合や、リアプロジェクションテレビを組立た時に、全反射式フレネルレンズのスクリーンと映像投写装置（１）との位置関係に誤差が生じている場合には、全反射式フレネルレンズへの入射角度θ１（図５（ｃ）参照）にも変化が発生し、その結果、光線が全反射式フレネルレンズ出射面に入射するときの角度θ３も０度からずれた値になる。この様な場合、全反射式フレネルレンズ（５）の出射面で反射した光線Ｌｒは図４（図３Ｂ部拡大図）に示す経路で全反射式フレネルレンズ（５）から出射する。即ち、打ち上げ角度ξで投写した光線は全反射式フレネルレンズ（５）にθ１の角度で入射し、スネルの法則により入射面でψ１の角度に屈折・進行する。入射後の光線は全反射式フレネルレンズ（５）の反射面Ｐｒにθ２で入射する。反射面Ｐｒに入射した光線は反射角θ２で反射し、全反射式フレネルレンズ出射面Ｐｏ（平面）に進行する。全反射式フレネルレンズ出射面Ｐｏに進行した光線は、入射角θ３で出射面Ｐｏに入射し、その大部分が出射面Ｐｏからその前方に出射し、映像として観測者に認識されるが、一部は反射角θ３で反射して、入射面Ｐｉに入射角Θ４で再度入射する。入射面Ｐｉに再入射した反射光線Ｌｒは反射角Θ４で反射されて反射面Ｐｒに入射角Θ５で入射し、角度Ψ５だけ屈折して反射面Ｐｒから出射する。この場合の反射光線Ｌｒと水平軸ｈとの成す角度ξｒは入射光線Ｌｉの打ち上げ角度ξよりも小さくなる。この結果、図３に示すように、反射光線Ｌｒが折り返し用平面ミラー（３）に浅い角度ξｒ（ξｒ＜ξ）で入射して反射されるため、反射光線Ｌｒは全反射式フレネルレンズのスクリーン（４）に再度入射し、本来の画像には存在しない迷光（ゴースト像Ｇ）として画面の状態を悪化させる。

【０００６】本発明の目的は、上記のゴースト像を消去、または、肉眼で識別出来ないレベルまで軽減することによってリアプロジェクションテレビ画面の画質を向上することにある。

【０００７】

【課題を解決するための手段】本発明のリアプロジェクションテレビは、画像を形成する画像表示部を有し、画像表示部の画像を投写する映像投写装置と、画像を表示するスクリーンと、映像投射装置からの画像をスクリーン背面に投写する映像結像光学系とを備えたリアプロジェクションテレビにおいて、スクリーン背面が、全反射により入射光線を反射してその進行方向を変化させるプリズムを同心円状に配列して成る全反射式フレネルレンズで成り、プリズムで反射して全反射式フレネルレンズの出射面に入射する光線の入射角が０度又はほぼ０度で、且つ、全反射式フレネルレンズに入射する光線が水平軸となす角度ξと、全反射式フレネルレンズ出射面で反射して全反射式フレネルレンズの入射面から出射した反射光線が水平軸となす角度ξｒとの関係がξｒ≧ξを満たす様に、全反射式フレネルレンズ入射面側にある反射面の傾斜角度を設定したことを特徴としている。この結果、全反射式フレネルレンズ出射面で反射した反射光線の進行方向が、リアプロジェクションテレビ内部の折り返しミラーを介しても、スクリーンに再入射しなくなり、ゴースト像の発生が防止できる。なお、スクリーンは、全反射式フレネルレンズのみで構成、或いは、全反射式フレネルレンズと、全反射式フレネルレンズ出射面前方に配置したレンチキュラーレンズとを有する構成の何れでもよい。

【０００８】また、本発明は、スクリーンを構成する全反射式フレネルレンズの出射面に透過率を向上（反射率を減少）させる処理、即ち、無反射コーティング（ＡＲコーティング）を施す、或いは、全反射式フレネルレンズ出射面に、入射光を散乱する梨地処理を施したことを特徴としている。この構成により、全反射式フレネルレンズ出射面にゴースト像の原因となる透過しきれないで発生する反射光線の光量を減少させ、全反射式フレネルレンズに反射光線が再度入射する時には、その光量は肉眼では識別不能な状態にまで減少され、ゴースト像は画面上では肉眼で識別不能な状態となる。

【０００９】さらに、本発明のリアプロジェクションテレビは、画像をスクリーンに投影・結像させる映像結像光学系に複数の非球面ミラーを用いた構成、或いは、複数又は１つの非球面ミラーと投射レンズとの組み合わせで構成したことを特徴としている。このように、本発明は、投射レンズや平面ミラーに比べて、投写光線の打ち上げ角度ξ（スクリーンに入射する光線と水平軸との成す角度）を大きくできる非球面ミラーを用いているので、奥行きが非常に薄いリアプロジェクションテレビが実現できる。

【００１０】上記構成の本発明のリアプロジェクションテレビは、液晶パネルを有する映像投射装置のみならず、複数の微小ミラーをマトリクス状に配置し、前記微小ミラーの姿勢変化により照明光束を任意の方向に反射させて画像表示を行うミラーアレイを有する映像投射装置を用いることも可能である。

【００１１】

【発明の実施の形態】（第１実施形態）本発明の実施形態について図１、図２を参照にして説明をする。なお、図１は本発明のリアプロジェクションテレビの概略構成図、図２は、図１のＡ部拡大図で、スクリーンに対する入・出射光線の経路を示す図ある。

【００１２】図１を参照にすると、本実施形態のリアプロジェクションテレビは、筐体底部に映像投写装置（１）が設置してある。この映像投写装置（１）は、画像表示部に液晶パネル（１ａ）を用い、液晶パネル（１ａ）で形成された赤（Ｒ）、緑（Ｇ）、青（Ｂ）の各画像光線がクロスプリズム（１ｂ）で合成されて出射する、所謂、液晶投写装置である。映像投写装置（１）の前方には投写結像用ミラー（２ａ）が設置してあり、投写結像用ミラー（２ａ）の上方に、光路がジグザグになるように投写結像用ミラー（２ｂ）～（２ｄ）が順次上方に向かって前後に互い違いに配置されて投写結像光学系が構成されている。これら投写結像用ミラー（２ａ）～（２ｄ）により映像光線は反射・折り返されて順次上方に進行する。最終段の投写結像用ミラー（２ｄ）の斜め前方の筐体内背面に折り返し用平面ミラー（３）が設置され、折り返し用平面ミラー（３）斜め上方前方筐体前面にスクリーン（４）が配置されている。映像投写装置（１）を出射した光線は、投写結像用ミラー（２ａ）～（２ｄ）、折り返し用平面ミラー（３）で反射・折り返されてジグザグに進みスクリーン画面（４）に投写・結像する。

【００１３】このように、本発明のリアプロジェクションテレビでは、本体奥行きをより短くする目的から、映像投写装置（１）とスクリーン（４）との間に映像投写用部品として非球面ミラーから成る複数の投写結像用ミラー（２ａ）～（２ｄ）及び折り返し用平面ミラー（３）を配置している。非球面ミラーはレンズ、平面ミラー等に比べて打ち上げ角度を大きくできるので、この投写結像用ミラー（２ａ）～（２ｄ）を用いることで短い投写距離で高倍率の画面となり、更に、投写光線（入射光線Ｌｉ）の打ち上げ角度ξが通常の投写レンズを用いた場合よりも大きくなる。この結果、スクリーン（４）への入射角度も大きくなり、平面ミラーやその他の部品が投射光線の折り返し反射に干渉、遮光されなくなるため、リアプロジェクションテレビの奥行きが大幅に薄く出来るようになる。

【００１４】スクリーン（４）背面には、図２、図５（ｃ）に示すように、平面ミラー（３）で反射した発散傾向にある光線を一定の方向に向ける目的で、個々のプリズムに全反射面Ｐｒ（以下、反射面と記す）を設けたプリズム群から成る全反射式フレネルレンズ（５）を設けて、映像光線を表示面であるスクリーン前面に垂直となるように曲げている。図５（ｂ）に示すように、屈折式フレネルレンズ（５ａ）をスクリーン背面に設けた場合は本発明の様な非常に高い打ち上げ角度ξの投写光線を水平軸に対し平行（θ３≒０度）に補正する事は困難となるので、本発明では屈折式フレネルレンズ（５ａ）ではなく、プリズムと同じ原理で光線の全反射を利用したフレネルレンズ、即ち、全反射式フレネルレンズ（５）をスクリーン背面に設けて光線の角度補正を行う構成としている。この、背面に全反射式フレネルレンズ（５）を設けただけのスクリーン構成で画面の光線視野角が狭くなる場合は、図５（ｃ）に示すように、シリンドリカルレンズの集合体であるレンチキュラーレンズ（６）を全反射式フレネルレンズ（５）の出射面に配置する事で画像の光線に広がりを持たせて視野角を広くする。スクリーン前面における視野角が広い場合はレンチキュラーレンズを設置する必要はない。本実施の形態では前者を採用し、全反射式フレネルレンズ（５）の前面にレンチキュラーレンズ（６）を設けたスクリーン構成になっている（図２ではレンチキュラーレンズは図示省略）。

【００１５】全反射式フレネルレンズ（５）を用いた構成では、図２（レンチキュラーレンズは図示省略）に示す様に、打ち上げ角度ξで投写した光線は全反射式フレネルレンズ（５）にθ１の角度で入射し、スネルの法則により入射角θ１とフレネルレンズ材質の屈折率ｎにより入射面でψ１の角度に屈折・進行する。入射後の光線は全反射式フレネルレンズ（５）の反射面Ｐｒにθ２で入射する。全反射式フレネルレンズ（５）はこの入射角θ２が臨界角θｃ（θｃ＝ｓｉｎ$^{-1}$（１／ｎ）、ｎはフレネルレンズの屈折率）以上（θ２≧θｃ）になるように反射面Ｐｒの傾斜角度β（反射面Ｐｒと垂直軸ｖとの成す角度）が設定されているので、反射面Ｐｒに入射した光線はプリズムの反射と同じ様に、理論上１００％の反射率で反射角θ２で反射し、全反射式フレネルレンズ出射面Ｐｏ（平面）に進行する。ここで、全反射した光線の進行角度は水平になる様に予め設定することで、全反射式フレネルレンズ出射面Ｐｏに入射する角度θ３は０度、または限りなく０度に近くなる（入射角θ３≒０度ならば、反射角θ３≒０度となる）。

【００１６】全反射式フレネルレンズ（５）は屈折式フレネルレンズと異なり、焦点距離ｆの概念はないので、スクリーンの各点に入射する打ち上げ角度ξ（ｙ）（ｙはスクリーン上の光線入射点の位置座標（垂直軸方向の座標））の光線が最終的に全反射式フレネルレンズ出射面Ｐｏに入射する入射角度θ３がθ３＝０度又はθ３≒０度となるように全反射式フレネルレンズ各入射面Ｐｉ

の面角度α（全反射式フレネルレンズの入射面Ｐｉと垂直軸ｖとの成す角度）及び反射面Ｐｒの傾斜角度βを設定する。しかし、理論上では、全反射式フレネルレンズ出射面Ｐｏに入射する光線の入射角度θ３をθ３＝０度又はθ３≒０度にできるが、実際にはスクリーンの微妙な撓み、傾き、スクリーンの基準位置と映像投写装置との位置関係の機械的ズレ等により、スクリーンを出射する光線は本来の設計値通りにはならないことが多い。そのため、上記問題点で述べた様な全反射式フレネルレンズの出射表面で発生する反射光線によってスクリーンの投写画面上にゴースト像が発生する。このため、本発明では、全反射式フレネルレンズ出射面Ｐｏに透過光量を向上させる処理、例えば、Ｓｉ膜とＳｉO_2膜を交互に積層した誘電体多層膜、或いは、ＴｉO_2膜とＳｉO_2膜を交互に積層した誘電体多層膜から成る無反射コート（ＡＲコート）を施し、ゴースト像となる反射光線Ｌｒの光量を減少させると共に、全反射式フレネルレンズ出射面Ｐｏで反射した反射光線Ｌｒが図４に示す反射光路を取らずに図２に示す反射光路を進行するように、即ち、全反射式フレネルレンズ出射面Ｐｏで反射して全反射式フレネルレンズ（５）から出射した反射光線Ｌｒと水平軸ｈとの成す角度ξｒが全反射式フレネルレンズに入射する入射光線Ｌｉの打ち上げ角度ξよりも大きくなる（ξｒ≧ξ）ように全反射式フレネルレンズ（５）の入射面Ｐｉの面角度α、及び反射面Ｐｒの傾斜角度β（図２参照）を特定の角度に設定して、全反射式フレネルレンズ出射面Ｐｏで反射した光線Ｌｒが折り返し用平面ミラー（３）に再入射してもゴースト像がスクリーンの投写画面上に現れないようにしている。

【００１７】このためには、図２に示すように、全反射＊式フレネルレンズ出射面Ｐｏに入射し、反射する光線が出射面Ｐｏの入射点下方から入射して上方へ反射進行し、その入射角度θ３が０度により近似するようにスクリーン各ポイントの全反射式フレネルレンズ入射面Ｐｉの面角度α、及び反射面Ｐｒの傾斜角度βを設定、即ち、全反射式フレネルレンズ出射面Ｐｏへの入射光路上方に反射光路があり、全反射式フレネルレンズ出射面への入射角度θ３を０度にできるだけ近い角度、即ち、近似的に０度とみなせる角度となるようにスクリーン各ポイントにおける全反射式フレネルレンズ入射面Ｐｉの面角度α、及び反射面Ｐｒの傾斜角度βを設定する。

$$\theta 1 = 90 - (90 - \alpha) - \xi = \alpha - \xi \quad \cdots (1)$$

$$\psi 1 = \sin^{-1}((\sin\theta 1)/n) = \sin^{-1}((\sin(\alpha - \xi))/n) \quad \cdots (2)$$

$$\theta 2 = (90 - \alpha + \psi 1) + (90 - \beta) = 180 - \alpha - \beta + \psi 1 \quad \cdots (3)$$

$$\theta 3 = 90 - \theta 2 - (90 - \beta) = \beta - \theta 2 \cdots (4)$$

$$\theta 4 = 90 - (180 - \beta - (90 - \theta 3)) = \beta - \theta 3 \quad \cdots (5)$$

$$\theta 5 = 180 - \gamma - (90 - \theta 4) - 90 = \theta 4 - \gamma \quad \cdots (6)$$

$$\psi 5 = \sin^{-1}(n \times \sin\theta 5) \cdots (7)$$

$$\psi 5 = 90 - \xi r - (90 - \alpha) = \alpha - \xi r \quad \cdots (8)$$

$$\alpha + \beta + \gamma = 180 \quad \cdots (9)$$

ここで、θ１は全反射式フレネルレンズ入射面Ｐｉへの入射光線Ｌｉの入射角度、ψ１は全反射式フレネルレンズ入射面Ｐｉにおける屈折角度、θ２は全反射式フレネルレンズ内に入射した光線の反射面Ｐｒへの入射角度、θ３は全反射式フレネルレンズ出射面Ｐｏへの反射面Ｐｒで反射した光線の入射角度、θ４は全反射式フレネルレンズ出射面Ｐｏで反射した反射光線Ｌｒの反射面Ｐｒへの入射角度、θ５は全反射式フレネルレンズ入射面Ｐｉへの反射光線Ｌｒ（出射面Ｐｏ、反射面Ｐｒで順次反射した光）の入射角度、ψ５は全反射式フレネルレンズ入射面Ｐｉでの反射光線Ｌｒの屈折角度（反射光線の出射角度）、ξは水平軸ｈに対する入射光線Ｌｉの成す角度（鋭角の方を採用、フレネルレンズへの入射位置、及び、投写光学系によって各々異なる。所謂、仰角である）、ξｒは水平軸ｈに対する反射出射光線Ｌｒの成す角度（鋭角の方を採用、所謂、俯角）、αは全反射式フレネルレンズ入射面Ｐｉの傾斜角度、即ち、入射面Ｐｉと垂直軸ｖ（水平軸に垂直な軸）との成す角度（α＜９０度）、βは全反射式フレネルレンズ反射面Ｐｒの傾斜角度、即ち、反射面Ｐｒと垂直軸ｖとの成す角度（β＜

【００１８】このように角度α、βを設定すると、出射面Ｐｏに進行した光線は、入射角θ３で出射面Ｐｏに入射し、その大部分が出射面Ｐｏからその前方に出射し、映像として観測者に認識され、残余の部分は反射角θ３で反射して、反射面Ｐｒに入射角θ４で再度入射する。反射面Ｐｒに再入射した反射光線Ｌｒは反射角θ４で反射されて入射面Ｐｉに入射角θ５で入射し、角度ψ５だけ屈折して入射面Ｐｉから出射する。この時、全反射フレネルレンズから出射した反射光線Ｌｒの角度ξｒは入射光線Ｌｉの打ち上げ角度ξよりも大きくなり、図１に示すように、再度スクリーンに入射することはないため、ゴースト像は発生しない。

【００１９】角度α、βの設定に当たっては、下記の関係式（１）～（９）を用い、θ３＝０度又はθ３＜０度（光線が出射面Ｐｏの入射点下方から入射するときをθ３＜０と定義し、図４のように、光線が出射面Ｐｏの入射点上方から入射するときをθ３＞０と定義した）で、且つ、θ３≒０度、ξｒ≧ξ、θ２≧θｃ、θ４≧θｃを満たす様に各面の角度α、βを設定する。

９０度）、γは全反射式フレネルレンズ先端部のエッジ角度、即ち、反射面Ｐｒと入射面Ｐｉの成す角度（通常は４０度～５０度の一定値をとる）、ｎは全反射式フレネルレンズの屈折率、θｃは臨界角（$\theta c = \sin^{-1}(1/n)$）、である。

【００２０】（第２実施形態）本実施の形態は、全反射式フレネルレンズ出射面に無反射膜を施した透過率向上処理に替えて、全反射式フレネルレンズ出射面に梨地処理を施している。この他の構成、即ち、全反射式フレネルレンズ入射面Ｐｉの面角度α、及び反射面Ｐｒの傾斜角度βの設定や映像投射装置（１）、折り返し用平面ミラー（３）、投射結像用ミラー（２ａ）～（２ｄ）の配置等は第１実施形態と同じである。

【００２１】全反射式フレネルレンズ出射面Ｐｏの梨地処理面に当たった光線は、透過、反射の両成分共に拡散光となる（拡散の度合いは表面の梨地の具合によって変化する）。このため、全反射式フレネルレンズ出射面Ｐｏで反射した成分は出射面Ｐｏの梨地処理により拡散する。仮に反射した光線の総量自体はそのままでも、単位面積（単位立体角）当たりの光線の密度は拡散により減少する。この結果、図３、図４に示すようなゴースト像となる光線の経路をたどる光量も少なくなり、ゴースト像は反射光線Ｌｒがスクリーン（４）に再入射した時には完全に消失するか、肉眼で識別できないレベルにまで減少している。

【００２２】尚、本実施の形態では、上述したように、ゴースト像は反射光線Ｌｒがスクリーン（４）に再入射した時には完全に消失するか、肉眼で識別できないレベルにまで減少しているので、全反射式フレネルレンズの各面の角度α、βの設定は必ずしも第１実施形態と同じにしなくてもよい。また、梨地処理した面に無反射膜（ＡＲコート）を設けると反射散乱する反射光が更に減少するので、ゴースト像防止効果が更に向上する。

【００２３】上記何れの実施形態も、結像光学系に非球面レンズから成る投映結像用ミラー（２ａ）～（２ｄ）を用いているが、図６に示すように、投映結像用ミラー（２ａ）～（２ｃ）（映像結像用ミラーは必ずしも３つである必要はない）と投射レンズ７で結像光学系を構成してもよい。

【００２４】また、映像投写装置（１）は、液晶パネル（１ａ）を用いた透過型の映像投写装置を用いた例を示したが、図７（ａ）、（ｂ）に示すように、微小ミラー（１２）をシリコン基板（１１）の表面にマトリクス状に配置して成る微小ミラー集合体で構成されたミラーアレイを用いてもよい。このミラーアレイは、図７（ｂ）に示すように、微小ミラー（１２）が捻れ梁（１３）により支持されてシリコン基板上に設置され、１つの微小ミラー（１２）で１画素を形成している。微小ミラー（１２）は、微小ミラー裏側のシリコン基板表面に設けたアドレス電極（１４）との間の静電吸引力により回転する。このように、アドレス電極１４に印加する電圧をオン・オフすることにより各微小ミラー（１２）の姿勢をそれぞれ変化させ、光源ランプ（１０）からの光Ｌの反射方向を変化させて画像を生成し、投写レンズ（７）により画像を投射する（図７（ａ））。

【００２５】

【発明の効果】本発明は、全反射式フレネルレンズ出射面にＡＲコートや梨地処理等を施して、ゴースト像発生の原因となる全反射式フレネルレンズの出射表面で生じる反射光線の光量を、反射光が画面上に再度出現した際に、その周りの部分と肉眼で識別出来ない位にまでに減少すると共に、全反射式フレネルレンズの反射面の傾斜角度β、及び入射面の面角度αを、反射光が再度スクリーンに入射出来ないような角度に設定したので、リアプロジェクションテレビの投写画面上に本来ならば存在しない光像、所謂、ゴースト像を消失、または、肉眼では識別出来ないレベルにまで減少できた。

【図面の簡単な説明】

【図１】　本発明のリアプロジェクションテレビの概略図。

【図２】　図１のＡ部拡大図で、ゴースト像が発生しないための入・出射光線の経路を示す全反射式フレネルレンズ断面図。

【図３】　ゴースト像発生経路を示す図。

【図４】　ゴースト像発生経路を示す図３Ｂ部拡大図（全反射式フレネルレンズ断面図）。

【図５】　（ａ）はリアプロジェクションテレビの概略図、（ｂ）は屈折式フレネルレンズを用いたスクリーン構成概略断面図、（ｃ）は全反射式フレネルレンズを用いたスクリーン構成概略断面図。

【図６】　本発明のリアプロジェクションテレビの概略図。

【図７】　（ａ）は多数の微小ミラーから成るミラーアレイを用いた映像投写装置の概略図、（ｂ）は微小ミラーの構成概略図。

【符号の説明】

１　映像投写装置
１ａ　液晶パネル
１ｂ　クロスプリズム
２ａ　投写結像用ミラー（非球面ミラー）
２ｂ　投写結像用ミラー（非球面ミラー）
２ｃ　投写結像用ミラー（非球面ミラー）
２ｄ　投写結像用ミラー（非球面ミラー）
３　折り返し用平面ミラー
４　スクリーン
５　全反射式フレネルレンズ
５ａ　屈折式フレネルレンズ
６　レンチキュラーレンズ
７　投写レンズ
１０　光源ランプ

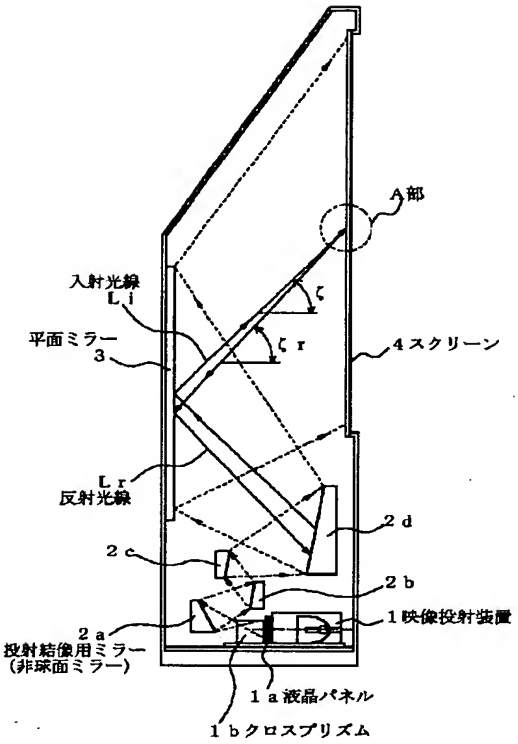
11

１１　シリコン基板
１２　微小ミラー

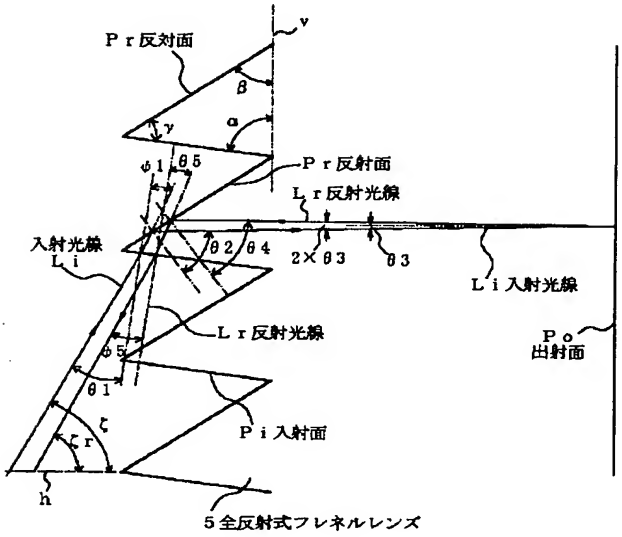
12

＊１３　捻れ梁
＊　１４　アドレス電極

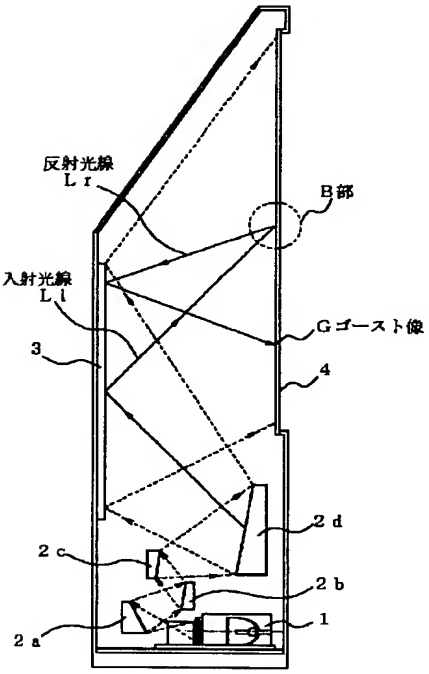
【図１】



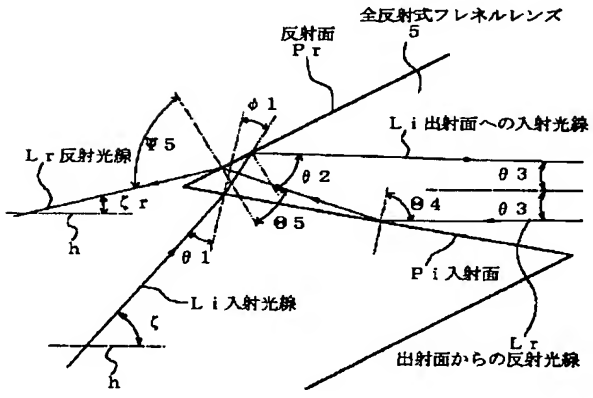
【図２】



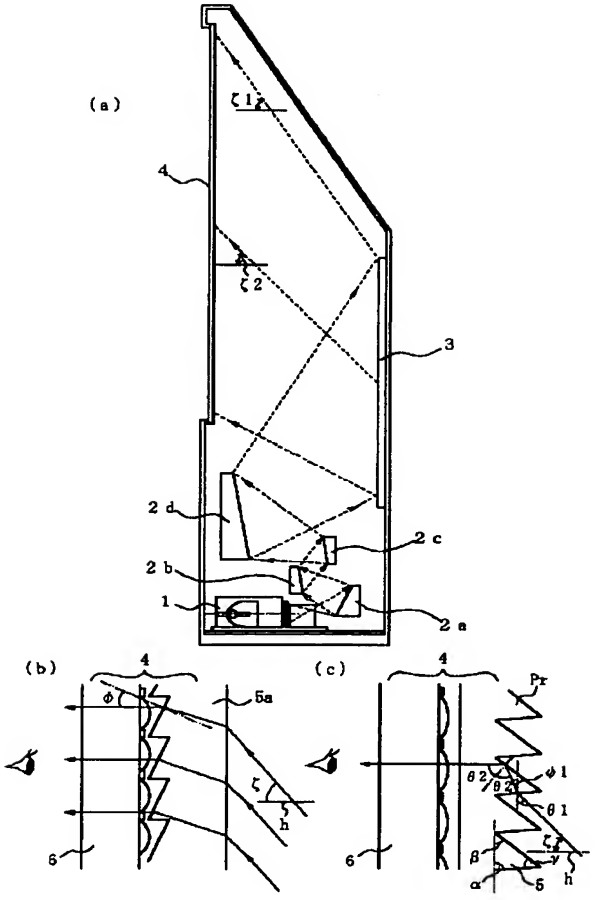
【図３】



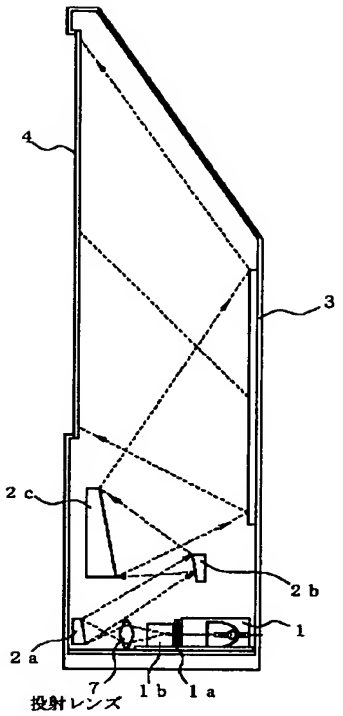
【図４】



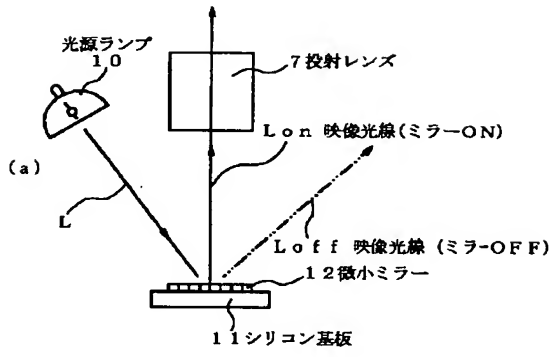
【図５】

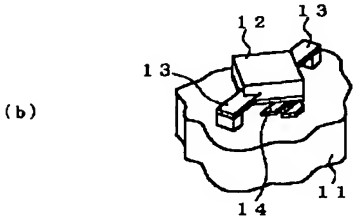

(a)
ζ1
4
ζ2
3
2d
2c
2b
1
2a
(b)
4
φ
5a
ζ
h
6
(c)
4
Pr
θ2
θ3
φ1
θ1
ζ
β
γ
h
α
5
6

【図６】


4
3
2c
2b
1
2a
7
投射レンズ
1b
1a

【図７】


光源ランプ
10
7投射レンズ
Lon 映像光線(ミラーON)
(a)
L
Loff 映像光線 (ミラーOFF)
12微小ミラー
11シリコン基板


(b)
12
13
13
14
11